TABLE OF CONTENTS

(continued)

SECTION 1

DESCRIPTION

This manual describes the installation and operation of Distributed Logic Corporation (DILOG) Model MQ606 Multifunction Controller. The dual-height controller interfaces up to two ST506/ST412 Winchester Disk Drives and up to two SA450 floppy disk drives to DEC* MicroVAX II, Micro PDP-11, or any LSI-11 Q-bus based computers.

The controller is software compatible with DU drivers in MicroVMS, DSM, RT-11, RSX-11M, RSTS, and ULTRIX operating systems. The controller supports both block mode and non-block mode memory and is programmable by the host software driver to transfer from 1 to 8 words per DMA request. The transfer rate for the floppy disk drive is 200/500 KHz per second, and for the Winchester drive is 5 MHz per second.

Figure 1-1 is a simplified diagram of the system using the multifunction controller.
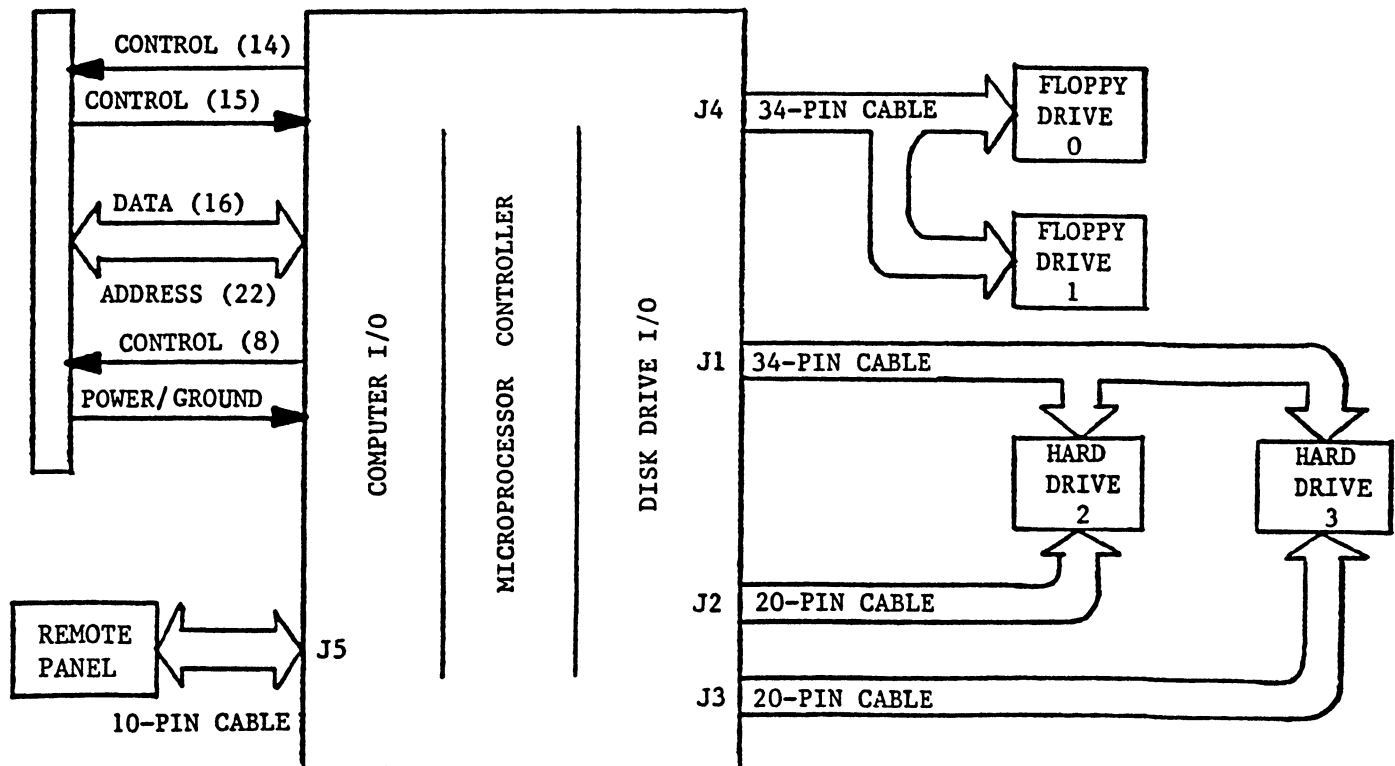

Figure 1-1. Disk System, Simplified

---

* DEC LSI-11, MICRO/PDP-11, MICRO/VAX II, RT-11, RSX, RSTS, RSTS/E, DSM, ULTRIX, MICRO/VMS, and DU Driver are registered trademarks of Digital Equipment Corporation

UNIVERSAL FORMATTING is a trademark of Distributed Logic Corporation.

CHARACTERISTICS

Characteristics of the controller are as follows:

Data Buffer

The controller contains an 8 KByte buffer to support a 1 to 1 sector interleave and reduce software generated latencies between the Q bus and disk drive.

Command Buffering

The controller contains a command queue buffer capable of storing up to 16 commands. The buffer stores all commands received by the controller and queues the commands for the proper order of execution on each drive.

Elevator Seek Ordering Algorithm

The controller uses an elevator seek ordering algorithm to determine the execution order for commands in the command buffer. This algorithm reduces drive seek latencies.

Overlapped Seeks

The controller supports overlapped seeks for two ST506/ST412 drives, with buffered seek capabilities and will start a transfer on the drive whose seek completes first. This feature reduces multiple drive seek latencies.

22-Bit Addressing

The controller supports 16-, 18-, and 22-bit Q-bus addressing.

Inhibit DMA Increment

The controller contains the ability to move blocks of data in or out of a specific memory or I/O address location. This is a special command that is software selectable for applications that require both incremental and non-incremental applications to run concurrently on the same controller.

NOVRAM (Non-Volatile Random Access Memory)

The NOVRAM replaces configuration switches typically found in controllers. Controller configuration is now contained within he NOVRAM even when power is removed. Information stored in the NOVRAM includes base address, boot enable/disable, boot address, default DMA burst size, DMA dwell time, and logical unit number of the drives connected to the controller. The configurations of the floppy drive and remote panel are also stored on the NOVRAM.

DILOG's Universal Formatting

Universal Formatting permits the attachment of Hard Disk Drives that have the same or different characteristics, such as number of cylinders, heads, sectors, capacities, and transfer rates, without the need for drive configuration components on the controller. The drive characteristics are stored on the drive itself and are passed to the controller when power is first applied.

Onboard Formatting

The onboard formatter is accessible through the system console or an optional remote panel. The onboard formatter writes and qualifies the header and data portion of each sector, allocates replacement sectors, and configures the RCT tables. The onboard formatter removes all requirements for distribution media.

Media Flaw Compensation

The following four functions are for the Hard Disk only, and are designed to compensate for media defects:

FIRST, at format time an area is reserved as a spare, Dilog's Universal Formatting system has the ability to reassign spare sectors for defective sectors, into this reserved area.

SECOND, if an error is encountered after the drive is formatted, the controller will try to reread the sector with ECC disabled.

THIRD, if the error still exists, ECC is used to recover the data. This computer generated 32-bit ECC polynomial is capable of correcting one error per sector that is 11 bits or less in length. Error packets are generated by the controller every time an error recovery operation is performed.

FOURTH, if the error still exists, reassignment of defective sectors is accomplished through a dynamic replacement scheme controlled by the controller or host software.

Hardware Bootstrap

The controller contains an onboard bootstrap support for RP02, RL01/02, RM02, RM05, RM80, RK06/07, RX02, TS11, TSV05, TM11, and DU driver devices. The onboard NOVRAM allows selectable bootstrap addresses, in addition to enabling, disabling the bootstrap. When the bootstrap is disabled, the controller will boot from the standard DEC module.

Automatic Self Test

The controller is supplied with an automatic self test function that is initiated each time power is applied. The controller performs additional tests each time it is brought online. A green card—edge LED is lit and remains lit after each successful completion of self test. Should self test fail, the controller isolates the disk drive from the system and the LED is extinguishes.

Remote Panel Interface

An interface connector is supplied for a remote panel. The panel itself is user-supplied. The panel contains four LED's and four switches for the functions drive online or write protection. The Controller Utility Program (Section 3) permits programming of the switches and LED's for either or both functions for any drive; for example, three drives may be programmed for write protect and one for online.

Disk Drives Supported

The controller is compatible with disk drives from the following manufacturers. Contact the factory for additional drive support.

Hard Disk

5-1/4" and 3-1/2"

ATASI	CONTROL DATA CORP.	FUJITSU
HITACHI	MAXTOR	MICROPOLIS
MICROSCIENCE INTERNATIONAL CORP.		NEC
PRIAM	SIEMENS	SEAGATE
TANDON		

Floppy Drives:

5-1/4"

CANON	CONTROL DATA CORP.	FUJITSU
HITACHI	MEMOREX	MICROPOLIS
MITSUBISHI	NEC	PANASONIC
QUME	SEAGATE	TANDON
REMEX	SONY	TEAC

3-1/2"

CANON	EPSON	FUJITSU
MITSUBISHI	NEC	PANASONIC
SONY	TEAC	

LSI-11 Q-BUS INTERFACE

Commands, data, and status transfers between the controller and the computer are executed via the parallel I/O bus (Q bus) of the computer. Data transfers are direct to memory via the DMA facility of the Q bus; commands and status are under programmed I/O. Controller/Q-bus interface lines are listed in Table 1-1.

Table 1-1. Controller/Q-Bus Interface Lines (Dual Module)

BUS PIN	MNEMONIC	INPUT/OUTPUT	DESCRIPTION
AJ1, AM1, BJ1, BM1, BT1, BC2	GND	O	Signal Ground and DC return.
AN1	BDMR L	O	Direct Memory Access (DMA) request from controller: active low.
AP1	BHALT L	N/A	Stops program execution. Refresh and DMA is enabled. Console operation is enabled.
AR1	BREF L	I	Used for Block Mode DMA.
BA1	BDCOK H	N/A	DC power OK. All DC voltages are normal.
BB1	BPOK H	I	Primary power OK. When low activates power fail trap sequence.
BN1	BSACK L	O	Select Acknowledge. Interlocked with BDMGO indicating controller is bus master in a DMA sequence.
BR1	BEVNT L	N/A	External Event Interrupt Request.
BV1, AA2, BA2,	+5	I	+5 volt system power.
AD2, BD2	+12	N/A	+12 volt system power.
AE2	BDOUT L	I/O	Data Out. Valid data from bus master is on the bus. Interlocked with BRPLY.
AF2	BRPLY L	I/O	Reply from slave to BDOUT or BDIN and during IAK.
AH2	BDIN L	I/O	Data Input. Input transfer to master (states master is ready for data). Interlocked with BRPLY.
AJ2	BSYNC L	I/O	Synchronize: becomes active when master places address on bus; stays active during transfer.
AK2	BWTBT L	I/O	Write Byte: indicates output sequence to follow (DATO or DATOB) or marks byte address time during a DATOB.
AL2, AA1, AB1, BP1	BIRQ4-7 L	O	Interrupt Request 4-7.
AM2 AN2	BIAK1I L BIAK1O L	I O	Serial Interrupt Acknowledge input and output lines routed from Q Bus, through devices, and back to processor to establish an interrupt priority chain.
AT2	BINIT L	I	Initialize. Clears devices on I/O bus.
AU2, AV2, BE2, BF2, BH2, BJ2, BK2, BL2, BM2, BN2, BP2, BR2, BS2, BT2, BU2, BV2	BDAL0 L through BDAL15 L	I/O	Data/address lines, 0-15.
AR2 AS2	BDMG1I L BDMG1O L	I O	DMA Grant Input and Output. Serial DMA priority line from computer, through devices and back to computer.
AP2	BBS7 L	I/O	Bank 7 Select. Asserted by bus master when address in upper 4K bank is placed on the bus. Also asserted for Block Mode DMA.
AC1, AD1, BC1, BD1, BE1, BF1	BDAL 16 L -BDAL21 L	O	Extended Address Bits 16-21

1-5

Hard Disk Drive Interface

The controller interfaces the hard drives through one 34-pin cable and up to two 20-pin cables. Signals for the 34-pin cable are listed in Table 1-2. Signals for the 20-pin cables are listed in Table 1-3.

Table 1-2. Hard Drive Control Cable - Controller to Drive - J1

Pin No.	Term	Description	Source
2	RWC/HSEL3 L	Reduce Write Current or Head Select 3	Controller
4	XHSEL2 L	Head Select 2	Controller
6	WGATE L	Write Gate	Controller
8	SKCPL L	Seek Complete	Drive
10	TRK00 L	Track 0	Drive
12	FAULT L	Write Fault	Drive
14	XHSEL0 L	Head Select 0	Controller
16	Not Used		
18	XHSEL1 L	Head Select 1	Controller
20	INDEX L	Index	Drive
22	READY L	Ready	Drive
24	STEP L	Step	Controller
26	DSEL0 L	Drive Select 0	Controller
28	DSEL1 L	Drive Select 1	Controller
30	DSEL2 L	Drive Select 2	Controller
32	DSEL3 L	Drive Select 3	Controller
34	DIR L	Direction	Controller

Note: All odd pins are DC ground.

Table 1-3. Hard Drive Data Cable - Controller to Drive - J2, J3

Pin No.	Term-J2	Term-J3	Description	Source
1	DSEL02 L	DSEL03 L	Drive Selected	Drive
2			Ground	
3			Not Used	
4			Ground	
5	WPRT2 L	WPRT3 L	*Write Protect	Drive
6			Ground	
7			Not Used	
8			Ground	
9			Not Used	
10			Not Used	
11			Ground	
12			Ground	
13	WDATA2 H	WDATA3 H	Write Data High	Controller
14	WDATA2 L	WDATA3 L	Write Data Low	Controller
15			Ground	
16			Ground	
17	RDATA2 H	RDATA3 H	Read Data High	Drive
18	RDATA2 L	RDATA3 L	Read Data Low	Drive
19			Ground	
20			Ground	

* Not supported on most drives.

Floppy Disk Interface

The controller interfaces the floppy disk drive through one 34-pin cable. If two floppy drives are used, the cable is daisy chained to the second drive. Signals for the cable are listed in Table 1-4.

Table 1-4. Floppy Drive Cable - Controller to Drive — J4

Pin No.	Term	Description	Source
2	SPDSEL L	*Speed Select/Reduce WRT	Controller
4	MOTOR L	Head Load	Controller
6	DSEL3 L	Select Drive 3	Controller
8	INDEX L	Index Pulse	Drive
10	DSEL0 L	Select Drive 0	Controller
12	DSEL1 L	Select Drive 1	Controller
14	DSEL2	Select Drive 2	Controller
16	MOTOR L	Motor On	Controller
18	DIR L	Direction	Controller
20	STEP L	Step	Controller
22	FWDATA L	Write Data	Controller
24	WGATE L	Write Gate	Controller
26	TRK00 L	Track 00	Drive
28	FWPRT L	Write Protected	Drive
30	FRDATA L	Read Data	Drive
32	XHSEL0 L	Select Head 0	Controller
34	READY L	Drive Ready	Drive

Note: All odd pins are DC ground.

* Three possible controller configurations for Pin 2:
    1) Speed Select (360 RPM/500 KHz data rate)
                    (300 RPM/250 KHz data rate)
    2) Reduce Write Current
    3) None of the above

Figure 1-2 shows the interface for a customer-supplied remote panel. The switches and LED connections depend on which drives are connected to J2 and J3. The LED's and switches may be programmed for write protect or online for any drive (see Section 3).
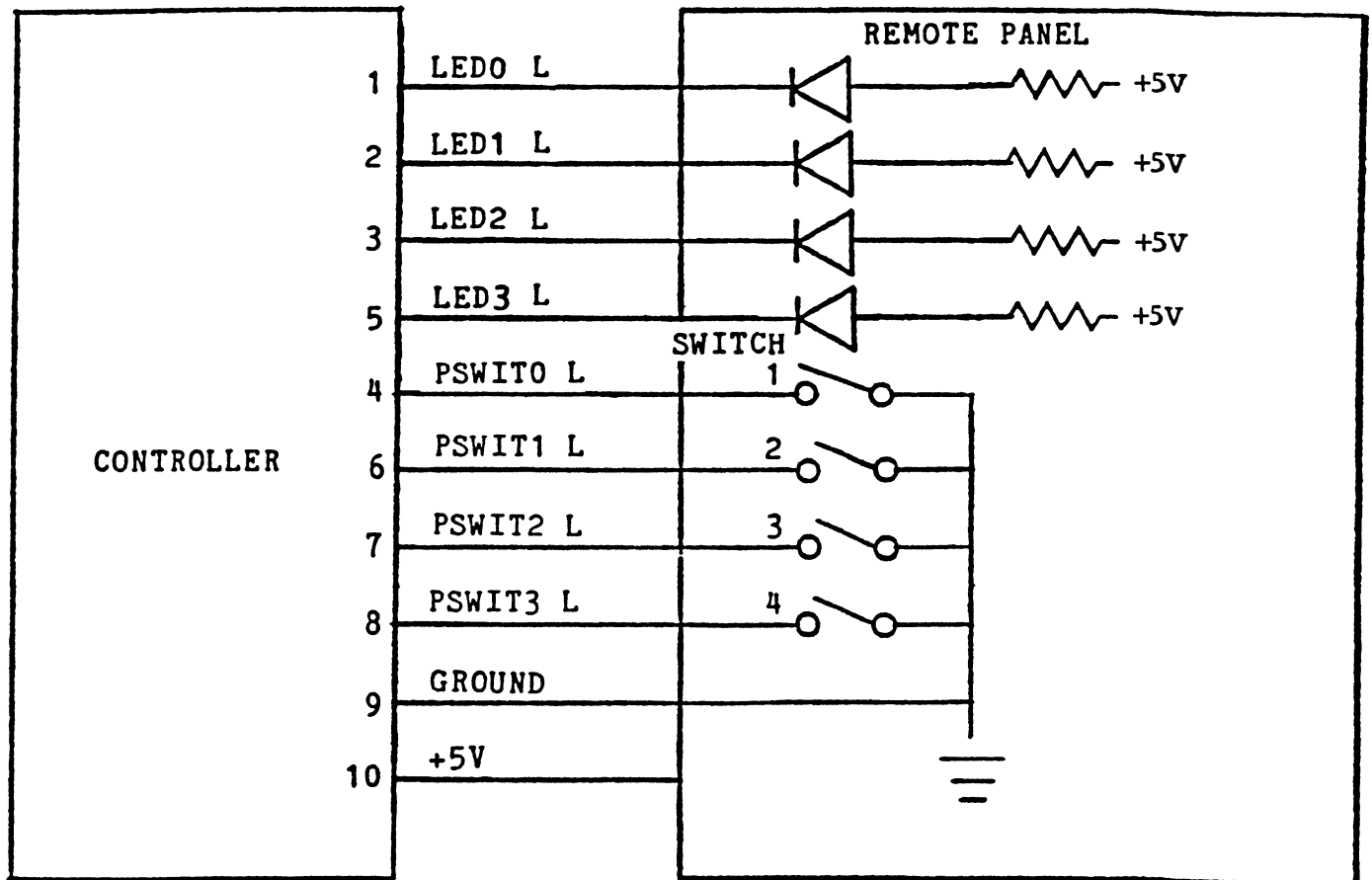
Figure 1-2. Remote Panel Interface

CONTROLLER SPECIFICATIONS *

Mechanical

The controller is completely contained on a dual-height module 13.2 cm. (5.22 in.) wide by 22.8 cm. (8.88 in.) deep and plugs into one standard Q-bus dual-height slot.

Base Address

Factory select 172150, user selectable from 160000 to 177774.

Interrupt Vector Address

Programmable by software.

Priority Level

BR5 in etch; BR4, 6, and 7 by jumpers.

DMA Burst Size

Software programmable 2-8 words.

Hard Disk Transfer Rates

5 MHz per second.

Floppy Disk Transfer Rates

250/500 KHz per second.

Hard Disk Drive I/O

One 34-pin flat ribbon cable and two 20-pin flat ribbon cables.

Floppy Disk Drive

One 34-pin flat ribbon cable.

Power

+5 volts at 2.0 amps.

Environment

Operating temperature 50 degrees F. (10 degrees C.) to 104 degrees F. (40 degrees C.); Humidity 10-90% non-condensing.

Shipping Weight

5 pounds including documentation and cables.

MTTR

Less than 0.5 hours.

* Specifications subject to change without notice.

INSTALLATION

INSPECTION

The padded shipping carton that contains the controller board also contains cabling for the disk drives. The controller is completely contained on the dual-height printed circuit board. Inspect the controller and cables for damage.

CAUTION

If damage to any of the components is noted, do not install. Immediately inform the carrier and DILOG.

Installation instructions for the drives are contained in the disk drive manuals. Figure 2-1 shows cable connections and jumpers for the interrupt level. The standard etch is for BR5. If another level is required, reinstall as indicated:

Level	JP3	JP2	JP1
BR4	Installed	Installed	Installed
BR5 (standard etch)	Removed	Installed	Installed
BR6	Installed	Removed	Installed
BR7	Installed	Removed	Removed

Figures 2-2, 2-3, 2-4, and 2-5 are examples of Dilog's recommendations for drive switch settings for floppy and hard disk drives. Consult the drive manufacturer's manual for other drives or more detailed information.

The following are requirements for setting drive switches:

Floppy Drive Switches or Functions	Floppy Drive Requirements
READY STATUS	Drives that support Ready Status are supported. Drives that do not support Ready Status are not supported.
MOTOR ON	The configuration should be set so that only MOTOR ON starts the spindle (not Head or Drive Select).
SPEED SELECT/REDUCE WRITE CURRENT	Pin 2 on the floppy drive cable supports:

	1) Speed Select (360 RPM/500 KHz data rate) (300 RPM/ 250 KHz data rate)
	2) Reduce Write Current
	3) None of the above
PHYSICAL UNIT	Always Units 0 and 1
TERMINATION	Single terminator on the last floppy drive

HARD DISK SWITCH OR FUNCTION	HARD DISK REQUIREMENTS
PHYSICAL UNIT	Hard disk drives are always Units 2 and 3
TERMINATION	Single terminator on the last hard disk drive

DIAGNOSTIC LED

PIN 1

HARD DISK CONNECTORS

HARD DISK CONNECTOR

REMOTE PANEL
CONNECTOR

FLOPPY CONNECTOR

J1

S/N

J2

MQ606
REV

DISTRIBUTED LOGIC CORP.

J5   J4 J3

COPYRIGHT 1986

INTERRUPT LEVEL

JP3 JP2 JP1
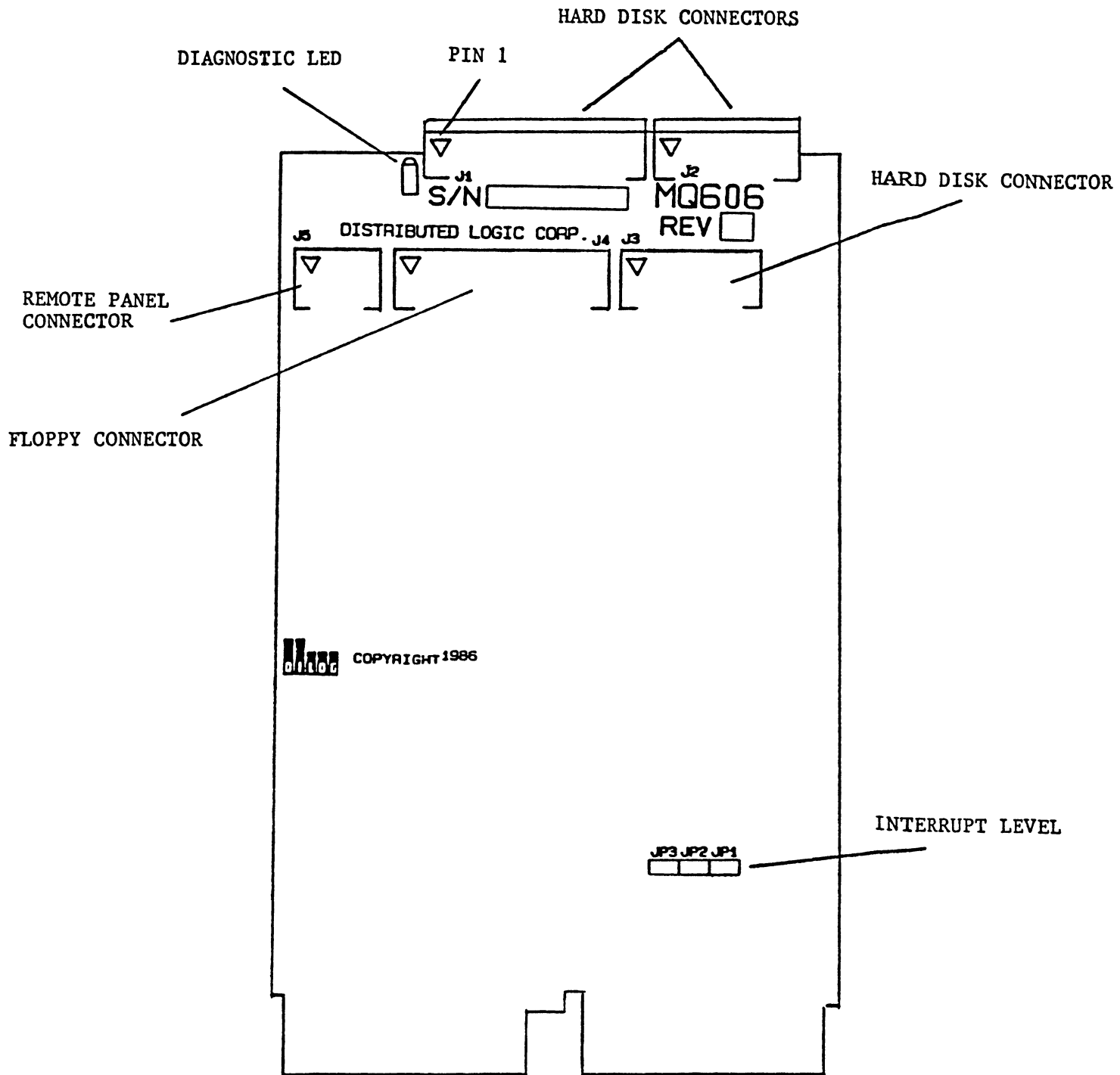
Figure 2-1.   Cable Connections and Jumpers

Manufacturer - Mitsubishi
Model No.   - MF504A

Dual Speed - 300 RPM, 360 RPM
Dual Data Rate - 250 Kb/s, 500Kb/s

PM1						PM2	PM3					PM7	PM9					PM10
DS2	DS1	DS0	MX	DS3	ND	TD	IS	IL	UD	IR	RR	SS	DC	2S	MM	MS	IU	SB
O	X	X	O	O	O	XX	O	O	O	S	S	S	O	O	S	O	O	O

```
O  = Open (Off)
S  = Shorted (On)
X  = Drive Select (User selectable)
XX = Termination Plug
         S/B Shorted on last floppy disk
```

Figure 2-2. Floppy Drive Switches - Mitsubishi

Manufacturer - NEC
Model No.   - 1155C

Dual Speed - 300 RPM, 360 RPM
Dual Data Rate - 250 Kb/s, 500Kb/s

USE		DRIVE SELECT					MOTOR ON			HS		LED					DENSITY			DISK CHANGE	
1	2	0	1	2	3	X	1	2	3	1	2	1	2	3	4	5	1	2	3	1	2
S	O	X	X	O	O	O	S	O	O	O	S	O	S	O	O	S	S	O	O	S	O

```
X = User definable drive select
S = Shorted (On)
O = Open (Off)
```

Figure 2-3. Floppy Drive Switches - NEC

```
Manufacturer - Control Data Corporation
Model No.    - 94155-86 (Wren II)
Capacity     - 86 MB (Unformatted)
Cylinders    - 925
Heads        - 9
```

```
         O     H     N     M     H
                                 A
                                 I
                                 D
        DS0   DS1   DS2   DS3   RADIAL

    |---|---|---|---|---|
    | 1 | 2 | 3 | 4 | 5 |
    |---|---|---|---|---|
    | O | O | X | X | O |
    |---|---|---|---|---|
```

Note: Remove terminating
      resistor pack except
      for last disk in
      daisy chain.

```
O = Open (Off)
S = Shorted (On)
X = User definable drive select
```

Figure 2-4. Hard Drive Switches - CDC

Manufacturer - Fujitsu
Model No.   - 2241AS, 2242AS, 2243AS

CNH3   CNH3

2241AS | 10 | 8 | 6 | 4 | 2 | 2243AS | 10 | 8 | 6 | 4 | 2 |
2242AS | 9 | 7 | 5 | 3 | 1 | | 9 | 7 | 5 | 3 | 1 |
        | O | O | O | O | S | | O | O | O | S | O |

2241AS
2242AS
2243AS

	(DSO)	(DS1)	(DS2)	(DS3)	(RADIAL)	(MOT ON ENA)	(MOT ON DISA)	(FULL BUFFER)

SW1

1	2	3	4	5	6	7	8
OFF	OFF	X	X	OFF	ON	OFF	OFF

O = Open (Off)
S = Shorted (On)
X = User definable drive select

Figure 2-5. Hard Drive Switches - Fujitsu

Other options, such as addresses, are stored in the firmware and are selected from the terminal as described in Section 3.

INSTALLATION

Install the controller as follows:

CAUTION

Ensure all power is off before installing the controller or cables.

Damage to the backplane assembly will occur if the controller is plugged in backwards.

1. Select the backplane location into which the controller is to be inserted. There are several backplane assemblies available from DEC and other manufacturers. Figures 2-6 and 2-7 show typical backplane configurations.

    It is important that all options slots between the processor and the disk controller be filled to ensure that the daisy-chained interrupt (BIAK) and DMA (BDMG) signals be complete to the controller slots. If there must be empty slots betwen the controller and any option board, the following backplane jumpers must be installed.

FROM	TO	SIGNAL
CO x NS	CO x M2	BIAK1/LO
CO x S2	CO x R2	BDMG1/LO

    ↑   ↑

2. If two hard drives are to be used, connect the cables to J1, J2, and J3. For the floppy use a single or daisy-chained cable and connect to J4.

3. Ensure the controller is oriented with the components facing row one, the processor, and gently press both sides until the module connectors are firmly seated in the backplane.

4. Connect the J1 cable to the hard drive or drives if daisy-chained. Connect the J2 and J3 cables to the hard drives. Connect J4 to the floppy or floppies if daisy-chained.

5. Refer to the disk drive manuals for operating instructions, and apply power to the computer and drive(s).

6. The system is ready for configuration and formatting as described in Section 3.

PROCESSOR

Q/Q Q/CD

12 11 10 9 8 7 6 5 4 3 2 1

A

B

C

D
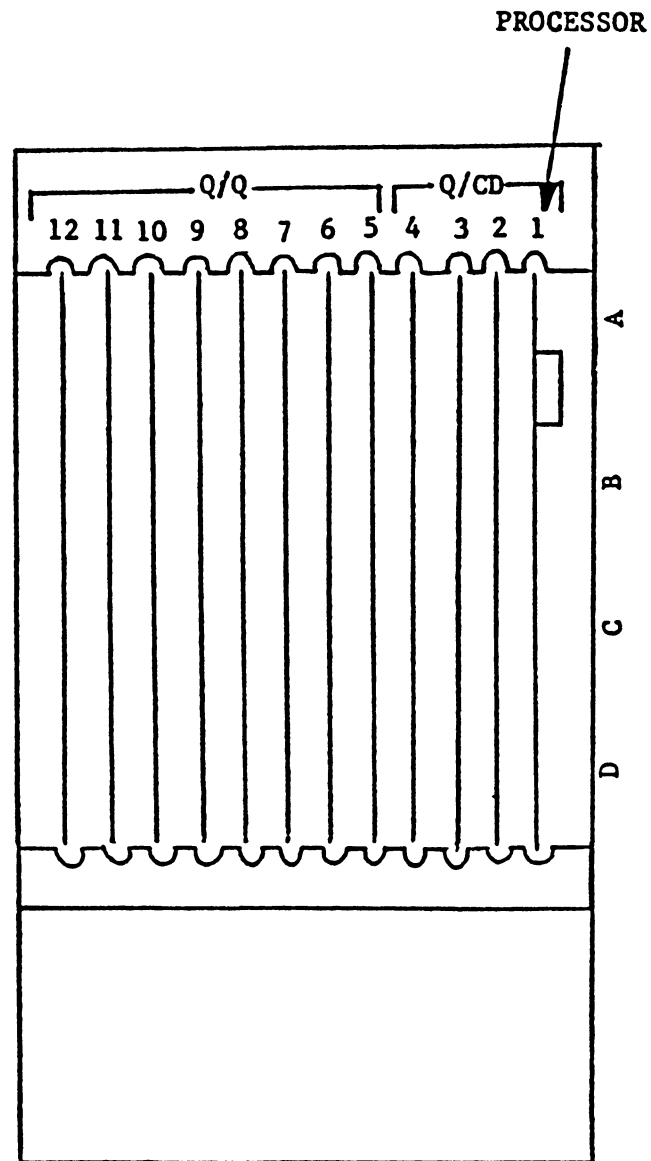
NOTE: Components on the board must be facing towards the Processor.

Figure 2-6. MicroVAX II Backplane (Typical)

PROCESSOR

INTERCONNECT SLOTS (Q/CD)
(ALL OTHERS Q-BUS SLOTS)

J3   J4

J1   A   B   C   D

1
2
3
4
5
6
7
8
} CONTROLLER
   LOCATION

J2
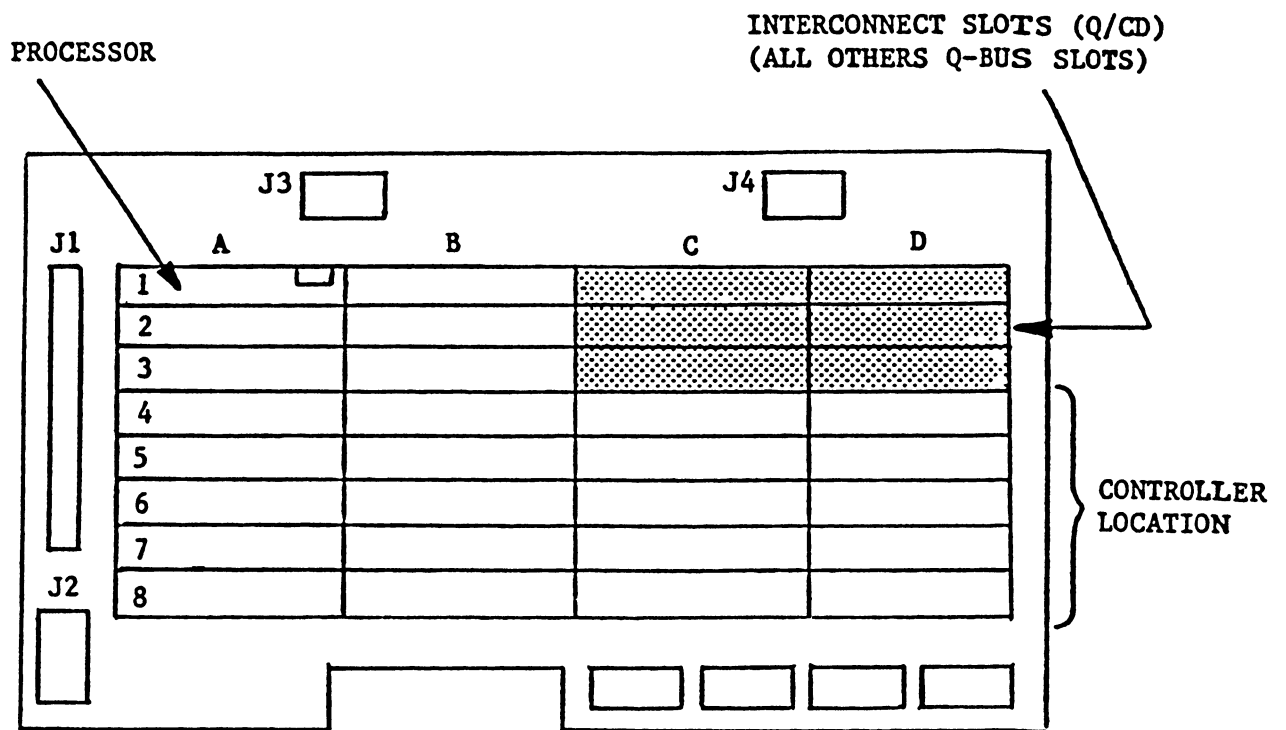
NOTE: Components on the board must be facing towards the Processor.

Figure 2-7. MicroVAX II H9278 Backplane

SECTION 3

OPERATION

The operation of the controller includes bootstrapping the system, setting the controller parameters, formatting the hard and floppy disk drives, running diagnostics, and checking the error logs.

There are several methods for bootstrapping and communicating with the formatting program:

- DILOG LSI-11 bootstrap procedure for several standard devices

- Onboard formatting procedure (FT)

- Standard DU Emulation

- Boot Disable

- Autoboot

- MicroVAX communications procedure

In the formatting program, the main menu offers the selections of the format utility, the controller utility, and display mode of the CRT or printer.

The first time the controller is powered up, the addresses will be:

IP Registers = 772150

Boot Address = 775000

Autoboot will be disabled

These addresses may be changed by the controller utility program, and the current addresses will be displayed on the logo.

DILOG LSI-11 BOOTSTRAP PROCEDURE

The following assumes the system is in ODT mode. Note that the bootstrap can be used under processor Power Up Mode 2 conditions. Refer to the appropriate DEC manual for a discussion of the Power Up modes. Further note that the disk drive does not need to be READY to enter the bootstrap.

Reset the system by pressing RESET (Break) or enter the following (characters underlined are output by the system; characters not underlined are input by the operator):

Boot Enable/Disable

The bootstrap is enabled or disabled through the Controller Utility program, under Set Controller Characteristics.

If the bootstrap is disabled, load the controller IP address with 0. Load the SA address (IP + 2) with 77777 (octal). Enter 2000G. For example, if the IP address is 172150 (SA = 172152), proceed as follows:

@   172150/0 <CR>

@   172152/005400 77777 <CR>

@   2000G

*

Boot for the device as described below.

If the bootstrap is enabled and the boot address is 175000, proceed as follows (enter):

@   7775000G

*

(If the bootstrap address is 173000, enter 7773000G.)

If Autoboot is enabled, load the IP address with 0. Load the Sa address (IP + 2) with 77777 (octal). Load locatio 0 with the controller IP address, enter 2000G. For example, if the IP address is 172150, proceed as follows:

@   172152/005400 77777 <CR>

@   0/172151 172150 <CR>

@   2000G

*

Boot the device as described below.

The controller not only supports standard DEC devices, but also allows the use of the onboard formatter. When DU is used, the standard DEC emulation is called. When FT is used, the onboard formatter is enabled for use through the system console.

*   Enter one of the following: DMO, DPO, DLO, DRO, MSO, MTO, DYO, DU, or FT <CR>

Definitions are as follows:

```
DM = RK06/07 Disk
DP = RP02/03 Disk
DL = RL01/02 Disk
DR = RM03/05/80 Disk
MS = TS11 Tape
MT = Tape
DY = RX02 Floppy Disk
DU = DU emulation
FT = Enable onboard formatter through system console
```

MICROVAX II COMMUNICATIONS PROCEDURE

A unique code is loaded into the SA register causing the controller to act as a UART. Proceed as follows:

1. On the MicroVAX II, perform INIT by depressing the RESTART switch.

2. Enter the code below. (Underlined values are outputs to the terminal.) The values of XXXXXXX are hex values of the controller address of the SA register and are listed below:

    >>>D/P/L 20088004 80000001 <CR>

    >>>D/P/W 20001F40 20 <CR>

    >>>D/P/W XXXXXXX 3FFF <CR>

    >>>S 200 <CR>

                           NOTE

    When a GPX (Graphics Work Station) is used enter
    >>>S 218 <CR> instead of 200.

The hex values of the addresses are as follows:

IP REGISTER OCTAL ADDRESS	SA REGISTER OCTAL ADDRESS	SA REGISTER HEX ADDRESS ENTERED
772150	772152	2000146A
760334	760336	200000DE
760340	760342	200000E2
760344	760346	200000E6
760354	760356	200000EE
760360	760362	200000F2
760374	760376	200000FE
760400	760402	20000102

For addresses other than the above (address range 16000...177774) perform the following:

1. Add 2 to the octal value of the IP register (SA address)

2. Convert the 4 LSB's in octal to hexadecimal.

3. Add 20000000.

For example, if the IP register is 160000, the hex value is obtained as follows:

1.   160000 + 2 = 160002 (octal).

2.   0002 (octal) = 002 (hex).

3.   20000000 + 002 = 2000002.

An optional step may be used to examine the values entered. After the first three lines are entered and before S200 starts, examine by entering and checking for the following:

>>>E/P/W   XXXXXXXX   800D

If 800D does not appear, there may be a problem in validating the memory maps. Contact the factory if this occurs.

CONTROLLER UTILITY AND FORMAT PROGRAMS

After communication is established, the program is ready to select controller options and to format the disks.

The formatter's terminal I/O interface supports the following keys:

-    DELete/Back Space: Delete the previous character input
-    CTRL-U: Delete the entire input
-    CTRL-C: Aborts the current process and returns to the menu
-    CTRL-P: Prints out current cylinder address on the printer
-    CTRL-S: (XOFF, Transmit Off); Stops the display on screen
-    CTRL-Q: (XON, Transmit On); Continues display on screen
                after CTRL-S

Inputs and outputs to or from the program are in decimal with the exception of the following:

-    IP/SA and Boot Address registers are displayed in octal.
-    Format data pattern is represented in hexadecimal.

With the exception of the priority level, the characteristics of the controller (such as IP address, burst size and boot status) are set by the program. Characteristics of a floppy or hard disk may be changed while the controller is online. In other controllers the characteristics are set by switches on the board. Drive characteristics (such as number of cylinders, heads, sectors) for hard drives are recorded on the drive.

Logo And Main Menu

With each menu selected, the logo will appear on the screen displaying the program title, model number, version, and IP/SA and boot addresses. Below the logo will appear which drive is selected or no drive is selected. The first menu to appear will resemble the following:

```
-----------------------------------------------------------------
  DILOG On-board Disk Formatter      IP/SA Address:  172150
  Model: MQ606     Version: A-A      Boot Address:   175000
-----------------------------------------------------------------
                   No Drive is Selected
```

     Main Menu
     ----

     1 - Format Utility
     2 - Controller Utility
     3 - Set Display Mode (CRT)

     Enter a Selection:

     The first time the controller is powered up, the IP/SA register
will always be 172150; the boot address will always be 175000. If
these addresses are changed with the controller utility program, the
last designated addresses will appear. In the version designation,
the first A represents hardware, the second software.

     In the main menu, the format utility program is used for drive
selection and configuration; the controller utility is used for con-
troller configuration; the display mode is for selecting either a
printer or CRT. If key 3 is pressed, the mode will toggle to either
CRT or Printer.

Controller Utility

     If a 2 is selected from the main menu, the controller utility
menu will be displayed after the logo. In the examples below, a
floppy drive is used to illustrate the program; however, other state-
ments are included for hard disk when applicable. The menu is as fol-
lows:

                   Drive 000 Selected (Floppy)

       Controller Utility Menu
       ----

       1 - Display Controller Characteristics
       2 - Set Controller Characteristics
       3 - Display Remote Panel Characteristics
       4 - Set Remote Panel Characteristics
       0 - Exit Menu

     Enter a Selection:

     If 1, Display Controller Characteristics, is selected, a display
similar to the following will appear:

Display Controller Characteristics

```
IP Addr:                        172150
Dwell Time:                     001
Default Burst Size:             008
Base DU Unit Number:            000

Boot Status                     Enabled
Boot Addr:                      175000
Auto-Boot:                      Disabled
```

** ** ** Press <CR> to Continue ** ** **

The dwell time is the time between DMA bursts in microseconds. The options are 1, 2, 4, 8, and 16 microseconds.

The default burst size is the number of DMA words for a block transfer. The burst size may be from 2 to 8 words.

The Base DU Unit Number is the logical unit number of a drive; this number may range from 0 to 252. The floppies are always assigned physical units 0 and 1. The hard disks are always assigned physical units 2 and 3. The hard disks are assigned the lowest logical base DU number. If there is only one hard disk on a system, the two floppies will be assigned the next two consecutive numbers.

The logical unit number and the physical unit number correspond roughly as follows:

DU BASE UNIT NUMBER = 0

Physical Drive	Logical Drive (DU)
0 - First floppy	2
1 - Second floppy	3
2 - First hard disk	0 (Base DU Unit Number)
3 - Second hard disk	1

In the following example, only one hard disk is used:

DU BASE UNIT NUMBER = 0

Physical Drive	Logical Drive (DU)
0 - First floppy	1
1 - Second floppy	2
2 - Hard disk	0 (Base DU Unit Number)

DU BASE UNIT NUMBER = 6

Physical Drive	Logical Drive (DU)
0 - First floppy	8
1 - Second floppy	9
2 - First hard disk	6 (Base DU Unit Number)
3 - Second hard disk	7

If 2, Set Controller Characteristics, is selected, a query session and responses similar to the following will appear:

Drive 000 Selected (Floppy)

Controller Characteristics Query Session

(CTRL-C ABORTS TO THE MENU)

IP Addr (160000...177774): <172150>

Dwell Time (1,2,4,8,16): <002>

Default Burst Size (002...008): <008>

Base DU Unit Number (0...252): <000>

Boot Status: (Enabled/Disabled): <E>

Boot Addr (173000/175000): <175000>

Auto-Boot (Enable/Disable): <D>

Modify Above Parameters (Y/N)? <N> No
Save Controller Parameters (Y/N)? <Y> Yes
NOVRAM Updated.
** ** ** Press <CR> to Continue ** ** **

NOTE

For the above changes to take effect, the controller must be powered down and powered up.

The ranges of values are in parenthesis. The default values are in carrots <> and will be the last selection made. The first four prompts, IP, Dwell, Default, and Base DU, are described above.

If Item 3, Display Remote Panel Characteristics, is selected, the switches will be displayed. The following is an example:

Drive 002 Selected

              Display Remote Panel Characteristics

                        Function   Physical Unit
        Switch 000   W   000
        Switch 001   O   000
        Switch 002   W   003
        Switch 003   D
        ** ** **   Press <CR> to continue ** ** **

In the above example, the functions represent Disabled (D), Write
Protect (W), or Online (O). The functions are as follows:

    -    Write Protect (W)   If the switch is ON, the assigned
                                  drive will be write protected. All
                                  write operations to the drive will
                                  be rejected.

    -    Online (O)   If the switch is ON, the assigned
                                  drive will be online. If OFF, all
                                  operations to the drive will be re-
                                  jected.

    -    Disabled (D)   If a switch is disabled, the state
                                  of the switch is ignored.

    If 4, Set Remote Panel Characteristics, is selected, the program
will prompt for each switch setting. The following is an example
using the three functions:

                    Drive 002 Selected   (XYZ)

         Remote Panel Characteristics Query Session

        (CTRL-C ABORTS TO THE MENU)

        Switch 000:
             Function (D,W,O): <D> W
             Physical Unit (0...3): <000>

        Switch 001:
             Function (D,W,O): <D> O
             Physical Unit (0...3): <000> 3

        Switch 002:
             Function (D,W,O): <D> D

        Switch 003:
             Function (D,W,O): <D>

        Modify above assignments (Y/N)? <N> No
        Save Remote Panel Parameters (Y/N)? <Y> Yes
        NOVRAM Updated.

        ** ** **   Press <CR> to continue **   ** **

Format Utility

If 1 is selected from the main menu, the Format Utility menu will be displayed after the logo. In the examples below a hard disk is used to illustrate the program; however, other statements are included for floppy drives when applicable. The menu is as follows:

```
------------------------------------------------------------
  DILOG Onboard Disk Formatter   IP/SA Address:  172150
  Model: MQ606    Version: A-A   Boot Address:   175000
------------------------------------------------------------
                   No Drive is Selected

    Format Utility Menu
    ------------------------

    1 - Select Drive
    2 - Display Drive Configuration
    3 - Format Drive
    4 - Bad-Block Scan
    5 - Rebuild Unit Control Block
    6 - Display Replacement Caching Table (RCT)
    7 - Replace Bad-Blocks
    0 - Exit Menu

    Enter a Selection:
```

Select Drive

A drive must be selected before other items may be entered. The floppies are assigned the first two Device Unit numbers (0,1), and the hard disks are assigned the next two (2,3). The Base DU Unit Number assignments are described under the Controller Utility Program.

If a floppy drive is selected, the parameters are read from the NOVRAM on the controller. If a hard disk is selected, the parameters are read from the UCB on the disk. If the UCB cannot be read from the drive, the program will present a query session. An example of a query session follows:

```
                  Drive 002 Selected

    Drive Characteristics Query Session
    -------------------------------------------
    (CTRL-C ABORTS TO THE MENU)

    Drive Name: XYZ

    Number of Cylinders: 615

    Number of Heads: 4

    Write Precomp Cylinder (0...00615): <00615>

    Current Reduction Cylinder (0...00615) <00615>
```

```
Dynamic Bad-Block Replacement Initiator:
       1) Host
       2) Controller
       3) None
Enter a Selection: <001> 1

RBN/LBN Ratio (001...050): <002>

Performs Buffered Seek (Y/N)? Y
```

The above queries are explained below after Display Drive Configuration.

Display Drive Configuration

If 2, Display Drive Configuration, is selected from the Format Menu, the display will be similar to the example below.

This example is based on the previous query session:

```
              Drive 002 Selected              (XYZ)

     Display Drive Configuration
     ---------------------------------

     Drive Name:                   XYZ
     Number of Cylinders:          00615   - Drive performs
                                             Buffered Seek
     Number of Heads:              004

     Number of Sectors per Track:  017

     Write Precomp Cylinder:       NONE
     Current Reduction Cylinder:   NONE

     RBN/LBN Ratio:                002      (0.2%)
     Number of RBNs allocated:     00000136 (002 Cyl)
     Bad-Block Replacement Initiator: Host

     Host Area Size (Blocks):      00076512
     Diagnostic Partition Size (Cyl): 00001

     ** ** **   Press <CR> to Continue   ** ** **
```

The drive name, number of cylinders, and heads may be obtained from the drive manufacturer's manuals. The numbers of sectors per track are fixed and are as follows: 17 for hard disk, 15 for 500 KB floppy, and 10 for 250 KB floppy. For a floppy, the write precompensation cylinder and current reduction are 44 if the drive requires write precompensation. For hard disks, write precompensation and current reduction may be obtained from the drive manufacturer's manuals. Use the value of all the cylinders if these functions are performed internally by the drive; for example, if there is no write precompensation and the drive has 615 (0-614) cylinders, enter 615. If the drive has more than 8 heads, current reduction will be performed by the drive internally; therefore, it will not be prompted for.

If the drive performs buffered seeks, a step rate is not required. If the response to Performs Buffered Seek is No, the drive step rate is required. The prompt will be: "Step Rate (1...7)". The step rate is the time it takes to move a head from one cylinder to another. The values entered in the program and the disk step rates are as follows:

PROGRAM VALUE	5.25 IN. HARD DISK	STEP RATES 5.25 IN. FLOPPY 250 KB	5.25 IN. FLOPPY 500 KB
7	12.8 ms	256 ms	128 ms
6	6.4 ms	128 ms	64 ms
5	3.2 ms	64 ms	32 ms
4	1.6 ms	32 ms	16 ms
3	0.8 ms	16 ms	8 ms
2	0.4 ms	8 ms	4 ms
1	0.2 ms	4 ms	

The Dynamic Bad-Block Replacement Initiator determines whether the host or controller will replace bad-blocks or if bad-blocks will be replaced at all. Furthermore, if the user selects None for Dynamic Bad-Block Replacement, there will be no RCT and RAM allocated for the unit.

If the controller is selected to replace bad-blocks, the replacement will be accomplished by the controller, and the replacement cycle will be transparent to the host.

If the host is selected to replace bad-blocks, the host must perform the algorithm which requires greater system overhead.

The next two items, Host Area Size and Diagnostic Partition, dif-
fer between floppy and hard disk. For a hard disk, there are three
partitions per drive, the Unit Control Block, the Host Partition, and
the Diagnostic Partition. The Host Partition consists of the Host
Area, the RCT, and the RBN. Figure 3-1 illustrates partitioning for a
floppy and a hard disk, and also if the Dynamic Bad Block Replacement
Initiator is None.

```
        FLOPPY                    HARD DISK              REPLACEMENT-
                                                            NONE

  -------------          --------------            -------------
 |             |        |    UCB      |<---1 Track--->|    UCB      |
 |             |        |-------------|            |-------------|
 |             |        |             |            |             |
 |             |        |    HOST     |            |             |
 |   HOST      |        |    AREA     |            |   HOST      |
 |             |        |             |            |             |
 |   AREA      |        |             |            |   AREA      |
 |             |        |-------------|<-Cyl.Boundary|             |
 |             |        |    RCT      |            |             |
 |             |        |-------------|<-Cyl.Boundary|             |
 |             |        | RBN BANK    |            |             |
 |             |        |-------------|            |-------------|
 |             |        |DIAG. PART.  |<-1 Cylinder-->|DIAG.  PART. |
 |-------------|        |-------------|            |-------------|
```

(RX50 format does not use Track 0.)

Figure 3-1. Drive Partitioning

The number of cylinders allocated for the RCT depends on the size
of the host area but is usually 1 or 2 cylinders. The Bank of Re-
placement Block Numbers (RBN) is selectable; this area may be between
0.1% and 5% of the Host Area as specified by the user. This RBN/LBN
Ratio is the number of replacement blocks allocated for each thousand
logical blocks. The default value is 2. In the above example, the
ratio is approximately 0.2% of the host area of the drive. The Diag-
nostic Partition size is 1 cylinder and is at the end of the disk,
except for floppy drives.

The UCB is the area where drive parameters are retained. The
Host Area is the user area. The RCT (Replacement and Caching Table)
is used for listing bad-media replacement. The RBN Bank (Replacement
Block Number) contains the replacement blocks for the Host Area.

The following is an example of a floppy configuration:

Display Drive Configuration

Number of Cylinders: 00080   - Constant Motor Speed
Number of Heads: 002   - Double Sided
Number of Sectors per Track: 010

Write Precomp Cylinder: 00044
Current Reduction Cylinder: NONE
Step Rate: 001
Data Rate: 00250 KB

Host Area Size (Blocks):   00001600
Diagnostic Partition Size (Cyl):   00000

Modify above parameters (Y/N)?   <N> No
** ** ** Press <CR> to continue ** ** **

NOTE

The drive is RX50 compatible if the drive is single sided and 250 KB.

Format Drive

After selection and configuration of the drives, they are ready for formatting, Item 3 from the Format Utility menu.

The program writes headers and a data pattern on the UCB. Then, the program writes drive parameters. Next, the drive parameters are read and validated.

The host format partition consists of the host area, the RCT, and the RBN bank. The sequence is: first, headers and a data pattern are written to the host partition. Second, the RCT is initialized (if an RCT has been allocated). During RCT initialization, the RBN area is scanned for bad blocks, and the bad RBN's are marked unusable in the RCT. Third, after RCT initialization, the host area is scanned for bad blocks. If bad blocks are found, they will be reported to the user, and the program will replace the bad LBN's with an RBN. If the user reponds "N" to the prompt, Replace Bad Blocks, the bad blocks will not be replaced.

If the selected drive is a hard disk, the Format menu is as follows:

                    Drive 002 Selected   (XYZ)

    Format Menu
    ----

    1 - Format Entire Drive
    2 - Format Diagnostic Partition
    0 - Exit Menu

    Enter a Selection: 1

    If 1, Format Entire Drive, is selected, the program will prompt for the data pattern and for replacing bad-blocks automatically. If 2 is selected, data on the host partition will not be affected.

    When the format is complete, a pattern similar to the following will appear:

                    Drive 002 Selected (XYZ)

    Format Drive   (XYZ)

    (CTRL-C ABORTS TO THE MENU)

    Data Pattern (0000...FFFF): <AA55>
    Replace Bad-Blocks (Y/N)? <Y>

    *** *** *** CAUTION *** *** ***
      If you continue, all data will
      be lost on the selected unit!
    *** *** *** *** *** *** *** ***

    Would you like to continue (Y/N)? <N> Yes

    Format UCB Partition:
        Writing headers/data
        Writing Drive Parameters
        Reading Drive Parameters

    Format Host Partition:
        Writing headers/data at cylinder: 00610
        Initializing RCT to No defect state ...
            RBN 00000015 is unusable.
        Bad-Block Scan at cylinder 00610
        Host Area Size (Blocks): 00041531

    Format Diagnostic Partition:
        Stepping to Diagnostic Partition...
        Writing headers/data at cylinder: 00614
        Diagnostic Partition Size (cylinders): 00001

    Format Operation Complete

    ** ** ** Press <CR> to continue ** ** **

NOTE

Rolling cylinder addresses will not be printed if
the display mode is set for PRINTER.

As each header is written, the rolling address of the cylinder is
displayed. If a bad sector is found during bad-block scan, the error
is reported.

For a floppy, a pattern similar to the following will be dis-
played:

```
                    Drive 000 Selected              (FLOPPY)

      Format Drive 000 (FLOPPY)
      ------------------------------
      (CTRL-C ABORTS TO THE MENU)

      Data Pattern (0000...FFFF): <AA55>

      *** *** ***   CAUTION  *** *** ***
         If you continue, all data will be
         lost on the selected unit!
      *** *** *** *** *** *** *** ***

      Would you like to continue (Y/N)?   <N>   Yes

      Format Host Partition:
           Writing headers at cylinder: 79
           Bad-block scan at cylinder: 79
           Host Area Size (blocks): 001600
```

If Item 4, Bad-Block Scan, is selected from the Format Utility
Menu, the program will scan for bad-blocks.

The function of a bad-block scan is to locate and replace bad
blocks on the selected unit. In order to find all the bad media on
the drive, retries will be disabled during bad-block scan. This will
allow the controller to detect all the soft errors and replace them
before the data is lost. Step One: Once a bad-block is located, the
retries will be enabled and the block will be read for the second time
as it will attempt to recover the data. Data is considered recover-
able if ANY data is retrievable from the bad-block during the second
read.

Next, the controller will write multiple copies of the host data
(bad LBN) on the drive (RCT partition) for safekeeping; the replace
cycle will not continue until the above step is successfully completed
and verified.

In step two of the replace cycle, a replacement sector (RBN) is
allocated for the bad LBN. The LBN will then be replaced with the
selected RBN during Step Three.

Next, Step Four: The host data is written to the RBN after the replace and revector operation has been verified. The host data is then read back and compared for final verification.

During data recovery, Step One, data status is recoverable if one of the following is true:

a) Successful read at the time when retries are enabled
b) Host data has been written with the forced error flag
c) Data is correctable
d) Data is non-correctable

The Forced Error flag will be set if none of the following is true:

a) Forced Error has been asserted
b) Data is non-recoverable

This process repeats over the entire host area.

If a floppy is selected, the following will appear:

                    Drive 000 Selected   (FLOPPY)

    Bad-Block Scan

(CTRL-C ABORTS TO THE MENU)

 Scan Host Area
      Bad-Block Scan at cylinder 00079

** ** ** Press <CR> to continue ** ** **

    If a bad-block on a floppy is found, it will be reported but not replaced.

    If a hard disk is selected, a display similar to the following will appear:

                    Drive 002 Selected   (NEC)

    Read Drive 002 (NEC)

(CTRL-C ABORTS TO THE MENU)

 Replace Bad-Blocks (Y/N)? <Y> No
 Bad-Block Scan at cylinder 00610
** ** ** Press <CR> to continue ** ** **

If the response is Yes, the following will appear:

*** *** *** CAUTION *** *** ***
    Non-Recoverable Bad-Blocks
    are replaced with Forced
    Error Flag set.
*** *** *** *** *** *** *** ***

Would you like to continue (Y/N)?   <N> Yes

Scan Host Partition:
    Bad-Block Scan at cylinder 00610
    Bad-Block found at LBN 0000L46 (Cyl: 00003, Head: 002,
    Sector: 008)
        Error Type: Correctable Data Field Error.
        Replacing LBN 00000L46 with RBN 00000005 (Non-Primary)
        Data Status: Recoverable
** ** **   Press <CR> to continue ** ** **

If 5, Rebuild Unit Control Block, is selected, the UCB is rebuilt
by: First, the program reads and tests the drive parameters and re-
ports the status of the UCB to the operator; second, the program for-
mats the UCB, rewrites drive parameters, and reads back the drive par-
ameters for verification. Data from the host partition in the drive
is not affected during this operation. After 5 is selected from the
main menu, the first display will be as follows:

Testing Unit Control Block ...

If the test is successful, the following will appear:

UCB is OK.

If the test fails, a display similar to the following will
appear:

UCB is Corrupted.

***** UCB READ ERROR: Non-correctable Data Field Error *****
** ** ** ** **   Press <CR> to continue   ** ** ** ** **

The above error message indicates the reason for the failure.
Furthermore, the error type corresponds to the error generated by
reading the last UCB copy.

NOTE

    Errors are listed below after the Replace Bad
    Blocks section.

The next display is:

*** *** ***   CAUTION   *** *** ***
If you continue, Unit Control Block on
the selected drive will be overwritten.
*** *** *** ***   *** *** *** ***

Would you like to continue (Y/N)? <N>

If the response is No, the program will exit to the main menu.
If the response is Yes, the program displays the current drive param-
eters and permits the user to modify the parameters, followed by:

Recovering Drive Parameters ... Rebuild Operation

If rebuild failed, a display similar to the following will appear:

Rebuild operation failed.

***** UCB READ: Non-correctable Data Error *****
** ** ** ** ** Press <CR> to continue ** ** ** ** **

NOTE

The Unit Control Block must be rebuilt with the same drive parameters with which it has been formatted previously.

If Item 6, Replacement Caching Table (RCT), is selected from the Format Utility menu, the table will be displayed page by page if a CRT is used, or will be printed completely if a printer is used.

The RCT is divided into blocks of 128 entries. In the example below, the first line, first column, specifies block 2. This is the first block of the RCT since the first two blocks are reserved for the host. The offset, 013, is the 14th (0-13) entry in that block. The Replacement Block Number is the allocated RBN. The logical block refers to the host area logical block number (LBN) which has been replaced by the above RBN. The status column entries are as follows:

A (Allocated-Primary):   The replacement block is primary.

U (Unusable):   The replacement block is unusable because of bad media.

A,NP (Allocated-Non Primary):   The replacement block was non-primary.

N (Null):   An entry does not have a corresponding replacement block. Null area indicates the end of RCT table.

The following is an example:

Display RCT

(CTRL-C ABORTS TO THE MENU)

Block	Offset	RBN	LBN	Primary-RBN	Status
00002	013	00000013	00000229	00000013	A (Alloc-Prm)
00002	014	00000014	00000000	00000000	U (Unusable)
00002	015	00000015	00000246	00000014	A,NP (Alloc-Non Prm)

Number of Allocated Replacement Sectors: 00000136
Number of Available Replacement Sectors: 00000133
** ** **   Press <CR> to continue   ** ** **

If 7, Replace Bad-Blocks, is selected, the following menu will appear:

                    Drive 002 Selected   (XYZ)

        Replace Bad-Block
        ----

        1 - Replace BFI
        2 - Replace LBN
        3 - Replace Sector
        0 - Exit Menu

        Enter a selection:

     Bad-blocks are replaced in the following sequence: First, the desired sector is read and the status of the sector is reported. Second, the program replaces the bad-block with an RBN as described in Item 4 of the Format Utility Menu, Bad-Block Scan.

     Replace BFI, Bytes From Index, refers to the location of the bad media (e.g., 135 bytes from the index). Refer to the Media Defect List supplied by the drive manufacturer. Replacement may also be by LBN, Logical Block Number, or by physical sector.

     If 1, Replace Bytes From Index, is selected, the following will appear:

Replace BFI

(CTRL-C ABORTS TO THE MENU)

Desired Cylinder (0...610): <000> 3
Desired Head (000...001): <000> 3
Desired BFI (00009...09741): 4600
     Reading LBN 00000246 (CYL: 00003, HEAD: 003, SECT: 008)
     - No Error Reported

*** *** *** CAUTION *** *** ***
   Non-Recoverable Bad-Blocks Are Re-
   placed with Forced Error Flag Set.
*** *** *** *** *** *** *** ***

Would you like to continue (Y/N)? Yes

Replacing LBN 00000246 with RBN 00000012 (Non-Primary)
Data Status: Recoverable

Replace More Bad-Blocks (Y/N)? <Y>

If 2, Replace LBN, is selected, the following will appear:

Drive 002 Selected   (XYZ)

Replace LBN

(CTRL-C ABORTS TO THE MENU)

Desired LBN (0...00041530): 0
     Reading LBN 00000000 (CYL: 00000, HEAD: 001, SECT: 000)
     Error Type: Forced Error

*** *** *** CAUTION *** *** ***
   Non-Recoverable Bad-Blocks Are Re-
   placed with Forced Error Flag Set.
*** *** *** *** *** *** *** ***

Would you like to continue (Y/N)? <N> Yes

     Replacing LBN 00000000 with RBN 00000000 (Primary)
     Data Status: Recoverable (Forced Error Set)

Replace more Bad-Blocks (Y/N)? <Y>

If 3, Replace Sector, is selected, the following will appear:

Replace Sector

Desired Cylinder (0...00610): <000> 003
Desired Head: (001...003): <002>
Desired Sector (0...016): 8

     Reading LBN 00000229 (CYL: 00003, HEAD: 002, SECT: 008)
     - Error Type: Sector Not Found

*** *** *** CAUTION *** *** ***
  Non-Recoverable Bad-Blocks Are Re-
  placed with Forced Error Flag Set.
*** *** *** *** *** *** *** ***

Would you like to continue (Y/N)? Y

     Replacing LBN 00000229 with RBN 00000010 (Non-Primary)
     Data Status: Non-Recoverable (Forced Error Set)

Replace More Bad-Blocks (Y/N)? <Y> N

Errors

     Error types and contexts are listed below. Error context de-
scribes what function was being performed when the error occurred. If
the error occurred during the Replace cycle, the Replace step will be
displayed as part of the error context. Error Type describes the error
which caused the process to be aborted. Errors are divided into four
categories: Recoverable, Non-Recoverable, Hard, and Fatal.

     Below is an example of an error which occurred when attempting to
access the RCT partition during Step One of a Replace cycle. The error
type indicates that the controller was not able to read any of the
multiple copies of the RCT; furthermore, the error generated from
reading the last copy was Sector Not Found.

****** RCT READ (REPLC STEP 1) ERROR: Sector Not Found *****

Error Type	Description
Correctable Data Field Error (R)	Bad media in data field; error is corrected using ECC.
Non-correctable Data Field Error (R)	Bad media in data field; length of error is too large to be corrected.
Forced Error (R)	Data written with Forced Error Flag; therefore data is questionable.
Sector Not Found (N)	Unable to locate a sector or header miscompare--probably bad media in header.

Error Type	Description
No Data Sync Field (N)	Data Sync Field changed due to bad media.
Header CRC Error (N)	Error in header.
Unit Not Selected (H)	Drive is not selected--possible bad connection, drive now powered up, or drive is not properly set.
Multiple Unit Selected (H)	More than one drive has the same physical unit number--check drive setup.
Drive Not Ready (H)	Drive did not spin up--perhaps drive power problem.
Write Fault (H)	Drive reported write fault.
Unit Write Protected (H)	The drive is write protected.
Unit Offline (H)	Unit is offline (via remote panel).
Seek Operation Failed (H)	Drive was not able to complete the seek, or the seek was to a wrong or nonexistent cylinder--check drive parameters.
Seek Time-out (H)	Seek command to drive not completed within the timeout period.
RCT Access Failed (H)	RCT partition corrupted.
Invalid Drive Characteristics (H)	Drive characteristics read from the drive are invalid. Could be unit control block is corrupted (use 5 from the Main Menu to rebuild Unit Control Block), or drive has not been formatted via Universal Formatter.
Abort Upon Operator Request (H)	Operator pressed CNTRL-C keys to abort operation.
Data Retrieval Failed (H)	After host data is saved on the diagnostic partition, the program verifies that the data can be retrieved from the diagnostic partition. If verification fails, this error is returned and host data is unaffected.
Media Format Error (ID/Sync) (H)	Controller could not locate header sync on the current cylinder--Drive may not be formatted.

Error Type	Description
Media Format Error (ID/CRC) (H)	Controller could not locate valid header on the current track--Drive may not be formatted.
Media Format Error (VF/Sync) (H)	Controller could not find sync on track during verification cycle-- Drive may not be formatted.
Replace Counter Exhausted (H)	During the replace cycle, up to 5 consecutive RBN's were allocated for the bad LBN. If all 5 RBN's are bad, this error is posted.
UDC Time-out (H)	Integrated circuit in controller timed out--repeat operation.
Fatal UDC-ric Error (F)	Fatal error--contact DILOG Customer Service.
Illegal Interrupt Ack- nowledge (F)	Fatal error--contact DILOG Customer Service.
FIFO Data Lost (F)	Fatal error--contact DILOG Customer Service.
Software Detected Fatal Errors (F) 01,02,03,04,05	Fatal error--contact DILOG Customer Service.

Error Context	Description
UNKNOWN	Operation unknown when error occur- red.
UNIT SELECT	Error occurred during unit select.
UCB READ	Error occurred when reading drive parameters from Unit Control Block; unable to read any of the multiple copies.
UCB WRITE	Error occurred when writing drive parameters to Unit Control Block; unable to write any of multiple copies.
RCT READ	Error occurred during reading an RCT block. Unable to read any of multiple copies.

Error Type	Description
RCT WRITE	Error occurred during writing to RCT block. Unable to write any of multiple copies.
READ	Error occurred during reading data from the host area.
WRITE	Error occurred during writing data to the host area.
FORMAT	Error occurred during formatting (writing headers) to the host area.
REPLACE	The error occurred when the program attempted to replace the bad LBN with an RBN.

Stand-Alone Errors	Description
INPUT OUT OF RANGE	Input is not within the expected range.
INPUT IS REQUIRED	No default for prompt.
RCT IS FULL	The Replacement Caching Table (RCT) on the selected drive is full. The drive should be reformatted.
INVALID DATA RATE	Data rate for floppy not 250 or 500 KB.
INVALID DWELL TIME	Dwell time not 1, 2, 4, 8, or 16 ms.
INVALID IP ADDRESS	IP address must be on longword boundary.
INVALID OPTION, NO RCT HAS BEEN ALLOCATED	Option attempted on a unit with no RCT.
INVALID FLOPPY OPTION	Items 5, 6, and 7 from the Format Utility Menu are for hard disk only.

Q-BUS POWER FAILURE DETECTED	Program detected power failure. At this time any drive that is selected will be deselected and the controller will isolate the drives and the host.
RCT SIZE CONFLICT	Either unit size too small or selected RBN/LBN ratio too large. Change RBN/LBN ratio.

DIAGNOSTICS

Three DEC RC25 diagnostics may be used to test the controller. They are ZRCFB3, Front End Test; ZRCDA1, Disk Exerciser; R ZRQAHO, RD/RX Exerciser.

SETUP AND SELF TEST

Install the controller as described in Section 2. Apply power to the system, and verify that the green LED lights. Install the XXDP+ diagnostic floppy in the floppy drive and boot the system. When the boot switch on the system is toggled, the LED will go out, but will light again when the controller is brought online by the diagnostic.

When booting is completed, the XXDP+ sign-on will appear:

```
XXDP-SM SMALL MONITOR VERSION 2
BOOT FROM DYO
28KW MEMORY
UNIBUS SYSTEM

RESTART ADDR: 152010
THIS IS XXDP-SM  TYPE "H" OR "H/L" FOR HELP
```

(NOTE: 28KW = 28 Kilowords)

FRONT END TEST ZRCFB3

The controller will only support tests 1-8 which must be selected by the user. These tests will bring the controller through initialization several times and do extensive checks on the DMA capability. Once the prompt "." has appeared, type the following command line to start ZRCFB3 diagnostic:

```
.R ZRCFB3
```

The system will echo the filename to let the user know that the file is being loaded.

```
.R ZRCFB3
ZRCFB3.BIN
```

When the diagnostic has been loaded, the diagnostic startup message will appear on the user's console.

```
DRSSM-FO
CZRCF-A-0
RC25 FRONT END/HOST DIAGNOSTIC
UNIT IS AZTEC RC25 PLATTER
RSTRT ADR 145676

DR>
```

The diagnostic can be started by typing the following command line:

```
DR>START/TEST:1-8<CR>
```

The above command line instructs the diagnostic supervisor to start the test but initiate only tests 1 through 8. The supervisor will then prompt the user for hardware or software changes.

```
CHANGE HW (L)  ?
```

The diagnostic must be informed of the hardware parameters of the system under test. Enter the following information.

```
CHANGE HW (L)  ? Y<CR>
```

Enter the number of controllers that are being tested.

```
# UNITS (D)  ? 1<CR>
```

The diagnostic will then prompt the user to enter the following information for the number of units that have been selected. The following is an example:

```
UNIT 0
IP ADDRESS (O) 172150  ? <CR>
VECTOR (O)  154  ? <CR>
BR LEVEL (O)  5  ? <CR>
PLATTER ADDRESS[ES] (D)  ? 0<CR>
```

The platter address is the unit number of the disk drive under test. Since the controller does not support the tests which require a disk, this question is not appropriate but must be answered to start the diagnostic. Once the hardware questions are answered, the supervisor will prompt for software changes.

```
CHANGE SW (L)  ?
```

The software question can be answered NO because the controller does not support the tests which require a disk drive.

```
CHANGE SW (L)  ? N<CR>
```

The diagnostic will print each test as it runs and will inform the user of any errors that occur.

```
TEST  1  REGISTER EXISTENCE TEST
TEST  2  STEP 1 READ/WRITE POWERUP DIAGNOSTICS
TEST  3  DIAGNOSTIC WRAP TEST
TEST  4  VECTOR AND BR LEVEL TEST
TEST  5  STEP 1-3 READ/WRITE DIAGNOSTIC
TEST  6  PURGE POLL TEST
TEST  7  SMALL RING TEST
TEST  8  LARGE RING TEST
```

When the diagnostic has completed all the tests, the end of pass message will be printed and the diagnostic will be restarted.

```
DZRCF     EOP     1
          0   TOTAL ERRORS
```

```
DR>EXIT<CR>
```

DISK EXERCISER, ZRCDA1

The controller is also compatible with the multi-drive exerciser, ZRCDA1. This diagnostic will bring the controller online and issue random record numbers to the selected unit(s). This diagnostic also supports multiple controllers as well as multiple units on a single controller.

Once the XXDP prompt "." is displayed, run ZRCDA1 by typing the following command line:

```
.R ZRCDA1<CR>
```

The system will echo the filename to inform the user that the program is being loaded:

```
.R ZRCDA1
ZRCDA1.BIN
```

Once the diagnostic is loaded, the diagnostics startup message will be displayed on the user's console:

```
DRSSM-FO
CZRCD-A-0
RC25 DISC EXERCISER
UNIT IS SINGLE RC25 PLATTER
RSTRT ADR 145676
```

```
DR>
```

Patch as follows:

	ADDRESS	IS	SHOULD BE
PATCH 1	26070	16237	12737
	26072	143326	50
PATCH 2	30644	1003	1367
PATCH 3	30704	1003	1367
PATCH 4	37522	1416	240

Start the test after the diagnostic supervisor prompt "DR>" appears.

        DR>START<CR>

The supervisor will then prompt the user to change hardware or software default parameters:

        CHANGE HW (L) ?

The diagnostic must be informed of the hardware parameters of the system under test. Enter the following command line to change hardware parameters:

        CHANGE HW (L) ? Y<CR>

Enter the number of controllers or drives that are currently being tested:

        # UNITS (D) ? 1<CR>

If 2 is entered the next prompt will appear twice so that the second controller or second drive may be selected.

The diagnostic will prompt the user to enter the following information for the number of units that have been selected:

        UNIT 0
        IP ADDRESS (O) 172150 ? <CR>
        VECTOR (O) 154 ? <CR>
        BR LEVEL (D) 5 ? <CR>
        PLATTER ADDRESS (UNIT PLUG) (D) 0 ? <CR>
        ALLOW WRITES TO CUSTOMER DATA AREA ON THIS PLATTER (L) ? Y<CR>
        ** WARNING - CUSTOMER DATA AREA MAY BE OVERWRITTEN! ...
            CONFIRM (L) ? Y<CR>

The platter address is the unit number of the disk drive under test. The customer data area is the host data area of the disk drive and is used to test the controller. Backup any data in the host partition, if necessary, before continuing with the diagnostic.

After the hardware questions are answered, the supervisor will prompt the user for any software changes:

CHANGE SW (L) ?

The user can take the default software values because the drives are larger than an RC25. If the tests are being run on a contracted unit, some of the software values may have to be changed to prevent errors from occurring.

If the selected unit is fully formatted, use the default values by typing NO to the software query:

CHANGE SW (L) ? N<CR>

To change the software default values, answer YES to the software query:

CHANGE SW (L) ? Y<CR>

The user will then be prompted by the supervisor to input the following information:

ERROR LIMIT (0 FOR NO LIMIT) (D) 32 ? <CR>

Enter the error limit that must be reached before a unit is de-selected by the diagnostic. The default value of 32 is used.

TRANSFER LIMIT IN MEGABYTES (0 FOR NO LIMIT) (D) 2 ? <CR>

Enter the number of bytes to be transferred between the controller and the diagnostic. Effectively, this selects the time required to reach an END OF PASS.

SUPPRESS PRINTING ERROR LOG MESSAGES (L) Y ? <CR>

The default value should be used unless multiple errors occur and more information is required to resolve the problem.

RUN DM EXERCISER INSTEAD OF MULTI-DRIVE SUBTEST (L) N ? <CR>

The default must always be taken because the controller does not support Diagnostic Mode (DM) of operation.

RANDOM SEEK MODE (L) Y ? <CR>

The best possible test is to seek randomly across the entire disk surface. Therefore, the default value should be used.

STARTING TRACK (D) 0 ? <CR>

The starting track number is to be entered. (Because the controller does not emulate the RC25, the questions regarding starting and ending track numbers do not apply. If the unit under test is fully formatted and is more than 40 megabytes, the diagnostic will not overflow the cylinder address.)

3-29

ENDING TRACK (D)   1641 ? <CR>

Enter the ending track number. If the unit is larger than an RC25 unit (40 megabytes), the default can be used.

READ-COMPARES PERFORMED AT THE CONTROLLER (L) Y ? <CR>

The default value is used to require the controller to compare the data read with host memory.

THE REMAINING QUESTIONS APPLY ONLY TO UNPROTECTED PLATTERS.

The user can use the default values for the remaining questions.

WRITE ONLY (L) N ? <CR>

The disc drive under test is never a write only disc; therefore, always take the default.

WRITE-COMPARES PERFORMED AT THE CONTROLLER (L) Y ? <CR>

The controller will perform write checks if the default is taken.

CHECK ALL WRITES AT HOST BY READING (L) N ? <CR>

The diagnostic will NOT issue read commands to check the data just written if the default is taken. Otherwise, the diagnostic software will perform the write check function.

USER DEFINED DATA PATTERN (L) N ? <CR>

The data pattern used in the diagnostic is worst case. To ensure prompt testing, always use the default value.

SELECT PREDEFINED DATA PATTERN (0 FOR SEQUENTIAL SELECTION)
(D) 0 ? <CR>

Always use the default value.

The test will begin after the hardware and software questions are answered.

INIT SUBTEST START

ABOUT TO VERIFY VECTOR 154(0) FOR DEVICE 172150(0) ...COMPLETED

The diagnostic will run until the transfer limit is reached. After the limit has been reached, the diagnostic will print status information about the unit under test and display the END OF PASS message:

CZRCD EOP   1
     0 TOTAL ERRS

DISK EXERCISER, ZRQAHO

The controller also exercises RQDX or RUX50. No patch is required. Enter the values, or <CR> as described below:

```
.R ZRQAHO
ZRQAHO.BIN

DRSSM-FO
ZRQA-H-0
RD/RX EXERCISER
UNIT IS RQDX OR RUX50
RSTRT ADR 145676
DR>STA

CHANGE HW (L)  ?  Y

# UNITS (D)  ?  2
*UNIT 0
IP address (O)  172150  ?  <CR>
Vector (O)  154  ?  <CR>
BR Level [usually 4-RQDX 5-RUX50]  (O)  4  ?  5
Drive number (D)  0  ?  0
Test entire customer area of this disk  (L)  Y  ?  Y
Lower octal word of beginning LBN address  (O)  0  ?  <CR>
Higher octal word of beginning LBN address  (O)  0  ?  <CR>
Lower octal word of ending LBN address  (O)  177777  ?  <CR>
Higher octal word of ending LBN address  (O)  0  ?  <CR>
Write on customer data area of this disk unit (L)  ?  Y
** WARNING - CUSTOMER DATA AREA MAY BE OVERWRITTEN! ... CONFIRM
                                                    (L)  ?  Y

*UNIT 1
IP address (O)  172150  ?  <CR>
Vector (O)  154  ?  <CR>
BR Level [usually 4-RQDX 5-RUX50]  (O)  5  ?  <CR>
Drive number (D)  0  ?  1
Test entire customer area of this disk  (L)  Y  ?  Y
Lower octal word of beginning LBN address  (O)  0  ?  <CR>
Higher octal word of beginning LBN address  (O)  0  ?  <CR>
Lower octal word of ending LBN address  (O)  177777  ?  <CR>
Higher octal word of ending LBN address  (O)  0  ?  <CR>
Write on customer data area of this disk unit (L)  ?  Y
** WARNING - CUSTOMER DATA AREA MAY BE OVERWRITTEN! ... CONFIRM
                                                    (L)  ?  Y

CHANGE SW (L)  ?  Y
```

*Logical DU Unit Number

Enter time as HHMM (example: 1505) (D) 0 ? <CR>
Hard error limit (D) 32 ? <CR>
Transfer limit in megabytes (0 for quick pass) (D) 0 ? 2
Percentage of "Fixed Disk" operations out of total operations
                                                    (D) 99 ? <CR>
Clear statistical tables after printing (L) N ? <CR>
Rewrite blocks when "Forced Error" detected on reads (L) Y ? <CR>
Halt on bad-block hard errors (#s 35, 38) (L) Y ? <CR>
Halt on other hard errors (#s 31-34, 36-37, 39-45) (L) Y ? <CR>
Halt on soft errors (#s 50-54) (L) N ? <CR>
Random seek mode (L) Y ? <CR>
Read-compares performed at the controller (L) Y ? <CR>
Running under the A.P.T. Monitor (L) N ? <CR>

The remaining questions only apply to unprotected disk units

Write-compares performed at the controller (L) N ? <CR>
Check all writes at host by reading (L) Y ? <CR>
User-defined data pattern (L) N ? <CR>
Select pre-defined data pattern (0 for sequential selection) (D)
                                                    0 ? <CR>
Manufacturing Test (L) N ? <CR>
Enable Host Memory (MSV11-P,L,J) Parity (L) Y ? <CR>

FUNCTIONAL TEST STARTED

ERROR LOGGING

Error messages for the disk subsystem are as follows:

Error Message Number	Description
0	Undefined error
1	Invalid Command
2	Command Aborted
3	Unit Offline
4	Unit Available
5	Media Format Error
6	Write Protected
7	Compare Error
8	Data Error
9	Host Buffer Access Error
10	Controller Error
11	Drive Error
12	Invalid CPU Type
13	Controller/drive contains unreasonable error rate
14	Cylinder 0 cannot be formatted
15	RCT area cannot be formatted
16	Drive not formatted